January 31, 2016

AUTOMATED VENT REGISTERS

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ABSTRACT

An automated vent register system modifies the opening of a vent register. The system determines an occupancy status and temperature of a room. Then, the system modifies the opening of a vent register in the room based on a combination of the occupancy status and the temperature in the room.

PROBLEM STATEMENT

Traditional centralized heating, ventilating, and air conditioning (HVAC) units pump hot or cold air into an area through air vents based on a desired temperature setting that can be, for example, set at a thermostat. HVAC units can create undesired temperature results, e.g., hot and/or cold zones, as different areas reach the desired temperatures at different rates. Additionally, traditional HVAC systems do not allow for fine tune control of temperature in different zones. To control the temperature in a specific room, e.g., a room occupied only at certain time(s) of the day, the air vent in the room would need to be opened or closed manually. Such systems result in undesired temperatures, inefficient cooling and/or heating, and inefficient energy usage. A system that provides a more efficient way to heat and/or cool a room by managing the opening or closing of the vents in the room is described.

DETAILED DESCRIPTION

The systems and techniques described in this disclosure relate to an automated vent register system. The system can be implemented for use in an Internet, an intranet, or another client and server environment. The system can be implemented as program instructions locally

on a client device or implemented across a client device and server environment. The client device can be any electronic device that controls the flow of air, e.g., cooled, heated, or purified, into a room such as an automated vent register.

Fig. 1 illustrates an example method 100 for modifying an opening of a vent register. The method can be performed by a system that manages a vent register, for example, the automated vent register system. Vent registers can be opened or closed to control the amount of HVAC air that flows into a room. Vent registers can be installed on a wall, ceiling, or floor of the room.

The system determines an occupancy status of a room (102). The occupancy status indicates whether one or more individuals are present in the room. If one or more individuals are present in the room, the system determines that the room is occupied. Alternatively, if no one is present in the room, the system determines that the room is unoccupied. The system can determine the occupancy status from data the system receives from various sensors, e.g., motion sensors, proximity sensors, IR sensors, and other imaging sensors, installed in the room. In an example, one or more sensors detect motion from one or more people in a room. The sensors can monitor and gather data pertaining to any motion or presence in the room. The system can be communicatively coupled with the sensors to receive data collected by various sensors. The system can then determine the occupancy status of the room based upon the data received from the sensors. From the sensor data, the system can determine that the occupancy status of the room is “occupied.” Alternatively, if data from the sensors indicate that no one is present in the room, the system can determine that the occupancy status of the room is “unoccupied.”

Further, the system determines a temperature of the room (104). The temperature of the room can be measure by one or more temperature sensors in the room. The system can be communicatively coupled with the temperature sensors to receive the temperature readings gathered by temperature sensors for the room.

The system modifies opening of a vent register in the room based on a combination of the occupancy status and the temperature in the room (106). The system can be implemented as program instructions locally on the vent register or communicatively coupled to the vent register. The system sends instructions to the vent register to modify its opening based on the combination of the occupancy status and the temperature in the room.

If the system determines the occupancy status of the room is “occupied,” the system can compare the temperature of the room and a desired temperature of the room to determine the degree to open the vent register. The desired temperature may be preset by a user or may be determined by the system based on past temperatures set by the user. The system can determine to close the vent entirely if the temperature of the room and the desired room temperature is the same or within a predetermined temperature difference threshold. The predetermined temperature difference threshold may be a user defined value, e.g., 10 degrees. For example, if the actual room temperature is 71 degree Fahrenheit, the desired room temperature is 75 degree Fahrenheit, and the predetermined temperature difference threshold is 10 degrees, the difference between the desired room temperature and actual room temperature is 4 degrees and within the predetermined temperature difference threshold. Therefore, the system determines to close the vent entirely.

Alternatively, or additionally, the system can determine to open the vent entirely if the temperature of the room and desired room temperature is not the same or outside a predetermined temperature difference threshold. For example, if the actual room temperature is 60 degrees, the desired room temperature is 75 degrees, and the predetermined temperature difference threshold is 10 degrees, the difference between the desired room temperature and actual room temperature is 15 degrees and outside the predetermined temperature difference threshold. Therefore, the system determines to open the vent entirely.

Alternatively, or additionally, the system can determine a degree of opening (or closing) of the vent based on the degree of difference between the temperature of the room and desired room temperature. For example, the system can calculate the ratio of the difference between the temperature of the room and the desired room temperature relative to the temperature of the room (or desired room temperature). The greater the ratio, the greater the system instructs the vent to open its vent.

In another implementation, the system modifies the opening of the vent register based on the occupancy status of the room alone. For example, if the determined occupancy status indicates that the room is “unoccupied,” the system can close the vent register completely, irrespective of the temperature in the room. In another implementation, the system opens or closes a vent if the temperature in the room is below a minimum temperature threshold or above a maximum temperature threshold when the room is unoccupied. For example, if a user sets a minimum temperature threshold of 60 degrees and a maximum temperature threshold of 80 degrees, the system can open the vent register if the temperature in the room is below 60 degrees or above 80 degrees, even when no one is present in the room.

In another implementation, the system modifies the opening of vent registers in a room based on a predicted occupancy status of the room. The system can determine the likelihood the room will be occupied in the future, e.g., within the next couple of minutes,hours, or days, and open or close the vent registers accordingly to adjust the temperature. The future occupancy status of a room can be programmed by a user, predicted by a model, or learned based on historical occupancy of the room. For example, the system can monitor historical occupancy patterns for an unoccupied room. Based on historical occupancy patterns, the system can determine the likelihood that the room will be occupied at different points in time in the future. If the likelihood that the room will be occupied for a particular point in time satisfies a predetermined threshold, the system can open or close the vent registers in the room to decrease the difference between a preset temperature for the room and the actual temperature of the room. For example, if the system determines that an unoccupied room is likely to be occupied in 30 minutes, the system can increase or decrease the opening of the vents to decrease the difference between the present temperature and actual temperature from 10 degree Fahrenheit to 3 degree Fahrenheit. This allows the system to prepare an unoccupied room for predicted occupancy by shifting the actual room temperature closer to a desired temperature, reducing the time it takes to reach the desired temperature quickly when the room actually becomes occupied. Additionally, if the system determines that an unoccupied room is not expected to be occupied in next few hours, the system may increase the temperature difference threshold or maintain the preset.

In another implementation, the system modifies the opening of the vent registers in a room based on the occupancy status of other rooms. The system can monitor occupancy status of all rooms in a particular home. The system can be programmed by a user or learn from historical

home occupant movement patterns to determine the likelihood that rooms will become occupied. If the likelihood that the room will be occupied at a particular point in time satisfies a predetermined threshold, the system can open or close the vent registers in the room to decrease the difference between a preset temperature for the room and the actual temperature of the room, as described above. For example, the system can monitor past occupancy patterns associated with an unoccupied room A when a room B, adjacent to or close to room A, is occupied. Based on the monitored patterns, the system may determine there is more than 50% probability that the unoccupied room A will become occupied within 30 minutes of room B being occupied. Therefore, the system modifies the vent registers in room A to get the actual temperature closer to the desired temperature.

The system can communicate with sensors installed in various rooms, determine occupancy status and temperature of each room, and independently modify openings of vent registers installed in various rooms based on the combination of their occupancy status and temperature. In an alternate embodiment, each room can have one or more ducts and each duct can have a damper which opens and closes the duct to deliver the right amount of hot and/or cold air to achieve the desired temperature of air for delivery to the room. The system can be implemented as program instructions locally on the damper or communicatively coupled to the damper. The system sends instructions to the damper to modify the opening based on the combination of the occupancy status and the temperature in the room.

Fig. 2 is a block diagram of an exemplary environment that shows components of a system for implementing the techniques described in this disclosure. The environment includes client devices 210, servers 230, and network 240. Network 240 connects client devices 210 to

servers 230. Client device 210 is an electronic device. Client device 210 may be capable of requesting and receiving data/communications over network 240. Example client devices 210 are personal computers (e.g., laptops), mobile communication devices, (e.g. smartphones, tablet computing devices), set-top boxes, game-consoles, embedded systems, and other devices 210' that can send and receive data/communications over network 240 may include smart appliances such as vent registers, HVAC units, refrigerators, coolers, ovens, microwaves, or any other home appliances. Client device 210 may execute an application, such as a web browser 212 or 214 or a native application 216. Web applications 213 and 215 may be displayed via a web browser 212 or 214. Server 230 may be a web server capable of sending, receiving and storing web pages 232. Web page(s) 232 may be stored on or accessible via server 230. Web page(s) 232 may be associated with web application 213 or 215 and accessed using a web browser, e.g., 212. When accessed, webpage(s) 232 may be transmitted and displayed on a client device, e.g., 210 or 210'. Resources 218 and 218' are resources available to the client device 210 and/or applications thereon, or server(s) 230 and/or web pages(s) accessible therefrom, respectively. Resources 218' may be, for example, memory or storage resources; a text, image, video, audio, JavaScript, CSS, or other file or object; or other relevant resources. Network 240 may be any network or combination of networks that can carry data communication.

The subject matter described in this disclosure can be implemented in software and/or hardware (for example, computers, circuits, or processors). The subject matter can be implemented on a single device or across multiple devices (for example, a client device and a server device). Devices implementing the subject matter can be connected through a wired and/or wireless network. Such devices can receive inputs from a user (for example, from a

mouse, keyboard, or touchscreen) and produce an output to a user (for example, through a display). Specific examples disclosed are provided for illustrative purposes and do not limit the scope of the disclosure.

DRAWINGS

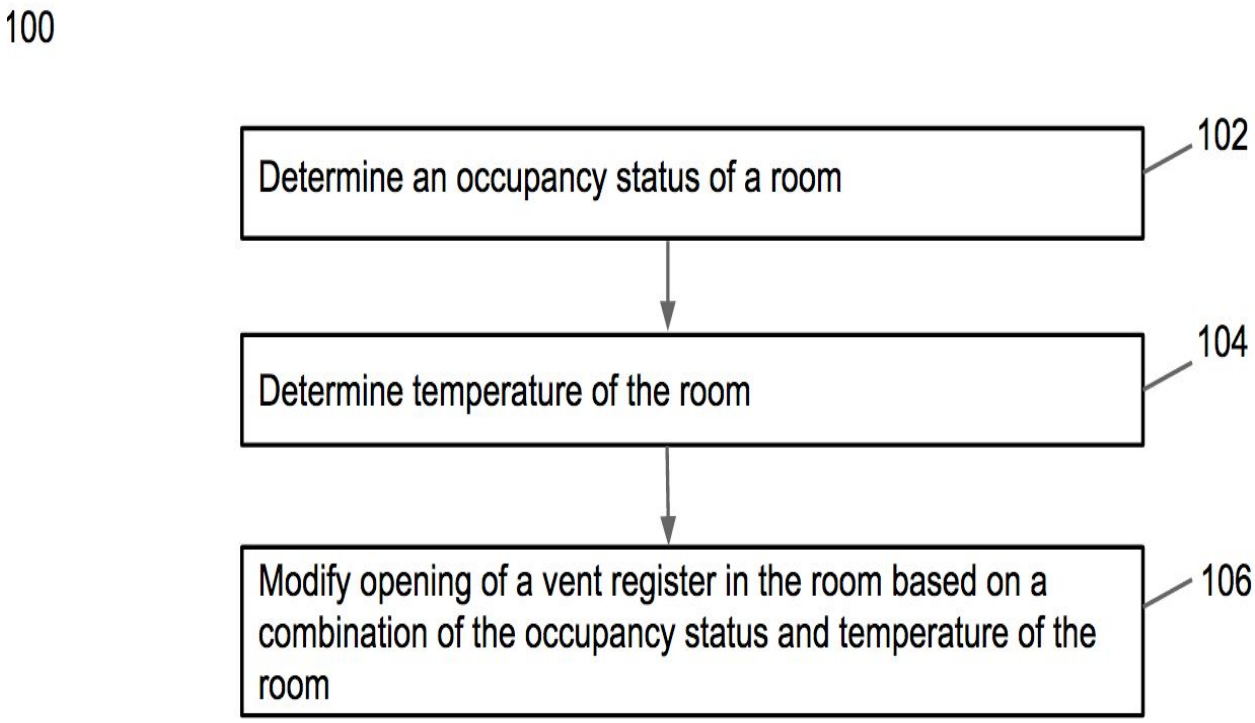

Fig. 1

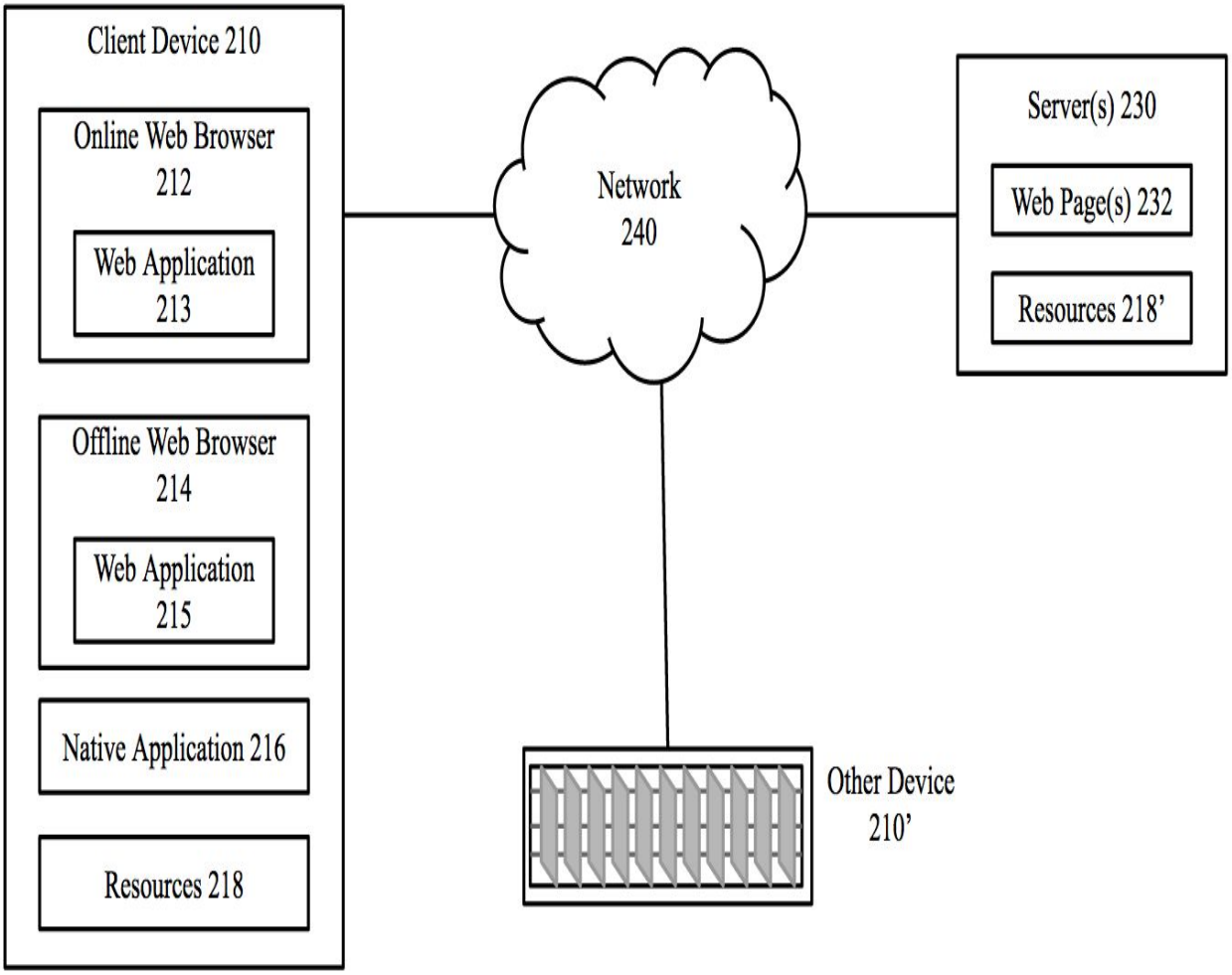
Client Device 210
Online Web Browser 212
Web Application 213
Offline Web Browser 214
Web Application 215
Native Application 216
Resources 218
Network 240
Server(s) 230
Web Page(s) 232
Resources 218'
Other Device 210'

Fig. 2